# CogniDrive: Cognitive Perceptual Attention Factors Reduce Distraction

Paul Hemeren (University of Skövde), Julia Mattsson (Distancify AB), Edin Pilipovic (Tivala AB), Eric Moragues (Autoliv AB) - Sweden

DDI 2024 MICHIGAN

## Introduction

- This research classifies driver reaction times according to a standardized cognitive attention metric that can be utilized for assessing safety contexts, which are then used to dictate adaptive human machine interface (HMI) functions in real-time.
- This experiment fills the knowledge gap in ADAS design by examining the integration of data derived from DMS, smart infrastructure-based sensing and Vehicle-to-Everything (V2X) communication technologies, through a theory-grounded data fusion subsystem.
- The major contribution of this research is the consolidation of driver and driving state features that are inherent to the physiological and cognitive attributes of individual drivers and unique driving contexts that incorporate vehicle and traffic features.

## Objectives

**Key Research Questions:**

- How does haptic attentional feedback affect the driver's reaction time, standalone as well as in combination with visual and auditory feedback?
- Is one modality as standalone or in combination the best way of providing attention warnings to the driver?

## Methods

- Autoliv's simulator (Figure 1) was used to conduct similar tests to NHTSA (2011). The same modalities in the NHTSA's study (2011) were tested. Eye-tracking was used to study eye gazing before, during and after the warning.
- Eight Experimental conditions *Figure 1*
  - Haptic (H), Visual (V)
  - Auditory (A)
  - Haptic-Visual (HV)
  - Haptic-Auditory (HA)
  - Visual-Auditory (VA)
  - Haptic-Vis.-Aud. (HVA)
  - No Feedback (NF)

## Methods

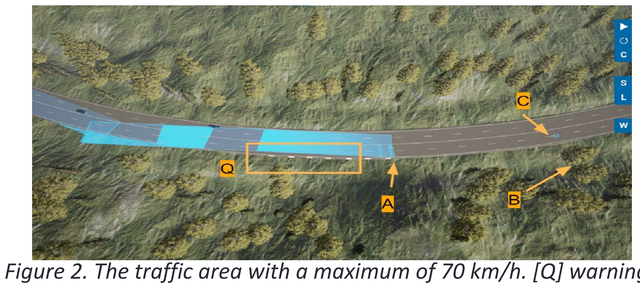


*Figure 2. The traffic area with a maximum of 70 km/h. [Q] warning zoon, [A] warning activation, [B] object*

- Participants were told to drive around the rural road of AstaZero at 70 km/h and keep right. Approximately three minutes in, the participant approached the warning-stretch, where they were about to get one of different warning combinations.
- Therefore, visual queries were placed [Q] 50 m before the automatic activation of visual and auditory warnings [A] to accurately time the manual button click with the automatic warning. When passing the blue column [A] the hidden animal [B] started animating towards the road [C] (Fig. 3).

*Figure 3*

- Reaction times were measured from the time of warning to the participant braking -using automated data to extract timestamps and confirming them using eye-tracking.
- Eye-tracking glasses were used to observe eye gazing and evaluate possible results.

## Results

- Primary results are the reaction times (Fig. 4) and crash percentages (Fig. 5) in relation to the different perceptual warnings.
- A significant RT difference between the haptic and the haptic-visual-auditory conditions in Fig. 4, via the multiple comparison post-hoc test LSD, p(0,026).
- There was also a similar significant difference between H and NF, p(0,036) and H and V p(0,028).

## Results

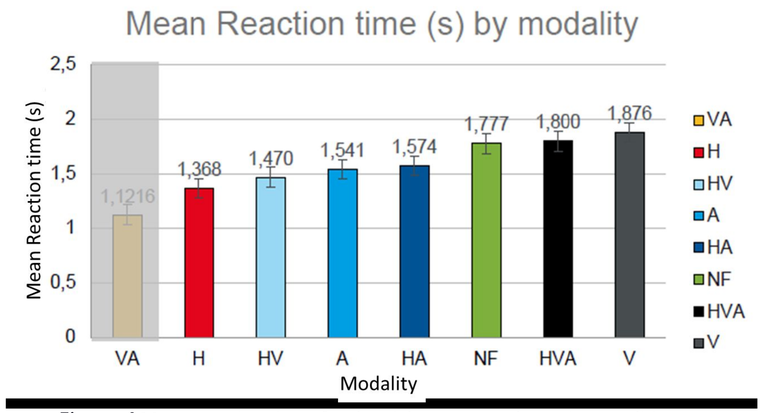


*Figure 4* Mean reaction times for the eight perceptual warning conditions.

- In Figure 5 for NF, crashes were 90%, and for H, 40%. And H was the only condition where there were fewer crashes than non-crashes.

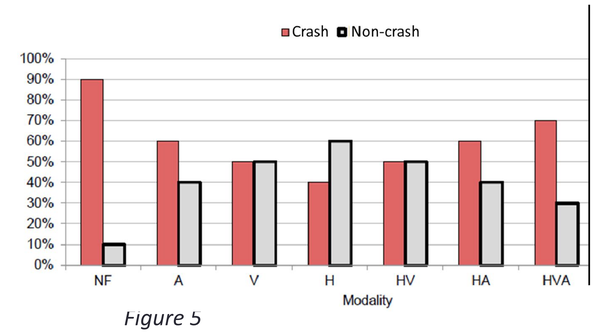


*Figure 5*

## Acknowledgement

- FFI-Vinnova - Turning Weak Evidence into Strong Safety Performance Scores, Vinnova – CogniDrive, and Autoliv AB is the study producer.

## Conclusions

- Haptic warning information has a positive effect for drivers' responce to distractions and to reduced crashes.

## References

1. Michelaraki, E., Katrakazas, C., Kaiser, S., Brijs, T., & Yannis, G. (2023). Real-time monitoring of driver distraction: state-of-the-art and future insights. Accident Analysis & Prevention, 192, 107241.
2. ITS Informal Group (2011). Guidelines on establishing requirements for high-priority warning signals with GRE comments to WP.29-150-22. United Nations Economic Commission for Europe